Contributions to the genetics of the China aster

Wit, Freerk

of the flower colour variation. This study has been made by LAWRENCE and SCOTT-MONCRIEFF (13) and by the cooperation of the latter author with some geneticists, she analysed the genetical material (27). At least seventeen different types of flower colour factor in ten species have been recognised during these investigations. Genes controlling glycosidal change proved to be very rare; 3–5-diglycosides were dominating to 3-glycosides, but the genetical analysis of these factors was incomplete. Therefore a gene of this type so far only has been completely analysed in the China Aster. That modification involving more oxydised anthocyanin pigmentation is dominant to less oxydised, has also been found by me. As for the other flower colour variations I refer to the cited paper. The China Aster will be of particular interest if it proves to be right that in the series of three allels the change from R to r^1 effects the change from the delphinidin to cyanidin series and that from r^1 to r the further change to the pelargonidin type.

In the introduction, in addition to the characters treated in the foregoing, the colour of the achenes and the variegation of leaves and flowers are also mentioned. Circumstances have rendered it impossible to discuss the crosses performed for the genetic study of these characters and the results obtained from these. This will be done in a future publication. The linkage values found between the genes will then also be communicated.

SUMMARY

The China Aster, *Callistemma chinensis* (L.) SKEELS has been known as a garden plant in Europe from the early part of the 18th century.

The wild plant is a two to three feet high annual with a rather thin rosette, spreading branches, violet blue female ray florets and yellow bisexual disk florets. All the now known varieties probably descend from the seeds originally send to Europe.

The differences between the habit types investigated are due to 3 pairs of allels. The wild plant (Typica) is PPNNCC. P influences the geotropical reaction of the branches; they form an angle of 45° with the stem. In pp plants the branches grow erect: Pyramidalis habit.

N effects the growing out of the basal internodes; nn plants have a greatly shortened stem and a large number of branches crowded at its base, through the inhibition of the growth in length from the formation of the radical leaves to shortly after the shooting from the rosette: Nana habit.

C influences the growth in length from the seedling stage during the whole development, and also the number of the internodes. In cc plants both the number and the length of the internodes are reduced which gives rise to a Compacta habit.

The effect of the different combinations of the dominant and recessive allels is given on p. 28.

Probably it later proves that the differences in habit are not due to those three pairs of allels only.

The wild Aster has a single flower-head. The difference between the single-and the double-flowered plant is monofactorial; single dominating, DD and Dd; dd is double.

In the quilled flower the corolla tube of the disk florets is not short (tubular) and coloured yellow by plastids, but shows a strongly tubular lengthening and is white or coloured by pigment dissolved in the cell-sap. The quilled character is incompletely dominant over the tubular character, the pair of allels is indicated by T–t.

The difference between the common type and the type with long and narrow ray florets the tops of which are more or less strongly curved, ostrich plume type, is not due to cooperation of length and width genes, but mainly to one gene, controlling the correlation of growth in length and growth in width, i.e. the shape-index. The symbols for this shape-index pair of allels are O–o; the common type OO, being not completely dominant over the ostrich plume type, oo.

The length and the largest width of the ligulate part of the ray florets vary strongly in the same plant. The shape-index, i.e. the length divided by the width, of the ray florets of the centre whorls of all flower-heads, however, shows a great uniformity and a slight mean error and is therefore characteristic for the whole plant. Determining this shape-index makes it possible to separate the different types in F_2 generations of crosses between the common and the ostrich plume type.

The rayonnant type with long and narrow ray florets which are

rolled up lengthwise and inwards to narrow tubes differs in one gene from the common type. The character flat ray florets of the latter dominates completely. RR and Rr plants have flat, rr plants rayonnant ray florets.

The differences between the commercial varieties in flower type are partly due to the different combinations of the analysed genes. Some genotypes are given on page 61.

The colour of the ray florets of the China Aster depends upon the presence of sap-soluble pigments of the anthocyanin and anthoxanthin type. Only the inheritance and the chemical composition of the former pigments have been studied. With the genetical analysis the colours are arranged in three groups in order of the intensity, viz. the standard, the intense and the dilute group. Each group has been subdivided in blue, purple and red shades. The flower colour of the wild plant is some shade of violet blue. With the analysis blue has been adopted as standard type. The genotype so far known is $WWMMRRiiSSP_aP_a$.

W is the most dominant of a series of three allels for general anthocyaninproduction W-w^d-w. It allows the production of large amounts of the pigment in the standard and intense group. In the presence of w^dw^d only dilute colours are possible. When ww is present no anthocyanin whatever can be formed.

M determines the glycosidic type of the anthocyanin. In all genotypes with MM and Mm there are two sugar residues attached at the anthocyanidin molecule, in all probability in separate positions; in all mm plants there is only one. Diglycosidic type is therefore dominant to monoglycosidic type. In the former case the colour is slightly bluer and deeper than in the latter.

R is the most dominant of the three allels R–r^l–r, which cause the difference between the blue, purple and red shades. Flowers of RR, Rr^l and Rr plants are blue or violet coloured by delphinidin glycosides, r^lr^l and r^lr plants have lilac or purple flowers, mainly coloured by the less oxydised cyanidin glycosides, while rr plants bear pink or red flowers, containing only the still less oxydised pelargonidin glycosides or a mixture of these with cyanidin glycosides. The three allels determine apparently the degree of oxydation of the anthocyanidin, the more oxydised type being dominant to the less oxydised.

I and S are responsible for the difference between the standard and intense colours. I is incompletely dominant to i, darkens the colour and makes it in the purple and red shades more blue. In the presence of rr cyanidin is added to the pelargonidin, in the presence of r^1r^1 presumably delphinidin to the cyanidin. Therefore I increases the degree of oxydation of the pigment present, the more oxydised being dominant to the less.

S is incompletely dominant to s and influences mainly the resistance of the colour to the bleaching effect of the sunlight. Especially in mm SS plants the resistance is very low. In ss plants the colour is fast and more intense. The chemical effect of these allels has not yet been found.

P_a seems mainly to determine the amount of pigment production, p_ap_a plants are pale. Chemically, however, most of the genotypes with p_a have not yet been analysed.

The effect of the different combinations of the colour genes on the flower colour is given on page 91.

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